DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

Office of the Assistant Secretary

NOV 28 1997

ACQUISITION POLICY 97A-004

MEMORANDUM FOR SEE DISTRIBUTION

FROM: SAF/AQ
1060 Air Force Pentagon
Washington DC 20330-1060

SUBJECT: Modeling and Simulation in Support of the Air Force Acquisition Process

References: (a) DoDD 5000.1, Defense Acquisition, 15 Mar 96

(b) DoD 5000.2-R, Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information Systems (MAIS) Acquisition Programs, 15 Mar 96

(c) DoD 5000.59-P, DoD Modeling and Simulation Master Plan, October 1995

(d) AFI 16-1001, Verification, Validation, and Accreditation, 1 June 1996

(e) HQ USAF/XOC, Air Force Modeling and Simulation Master Plan, 15 January 1996

(f) USD(A&T) memorandum, "DoD High Level Architecture for Simulations," 10 September 1996

(g) Systems Acquisition Manager's Guide for the use of Models and Simulations, Defense Systems Management College Press, 1994

(h) Draft AFPD 16-10, Modeling and Simulation (M&S), 25 June 1997

Today the Air Force is dedicating resources to build a force capable of meeting the military challenges of the twenty-first century. The implementation of Acquisition Reform has provided us a process to efficiently modernize our air and space forces. An integral part of this process is Modeling and Simulation (M&S). When effectively included in our acquisition strategy, M&S will help us to reduce cost, schedule, and performance risk in all functional areas; reduce time between concept definition and delivery of systems; reduce infrastructure and resource usage; improve system performance; and optimize system support requirements. Our goal is to make the Air Force Acquisition process more efficient and effective through the use of M&S applications and databases.

This policy shall apply to all acquisition programs in every acquisition category (ACAT) and is fully supported by Headquarters Air Force Materiel Command. Even though this policy applies to all acquisition programs, the requirement for specific uses of M&S will vary by program. The funds for implementation must come from the normal budgeting process, and may require program restructuring to accomplish this task within existing program budgets. Within one year of the date of this policy, Program Managers (PMs) shall report to their milestone decision authority their actions to implement this policy. As a minimum, PMs of ACAT ID programs shall brief SAF/AQ on their implementation efforts. Thereafter, all PMs shall brief their efforts to comply with this policy at each milestone review.

M&S strategy and requirements will be reflected in appropriate acquisition documentation, such as the Operational Requirements Document (ORD), Single Acquisition Management Plan (SAMP), Solicitation, Test and Evaluation Master Plan (TEMP), etc. For example, requirements for deliverable Digital System Models (DSMs) should be included in the ORD.

This policy is effective immediately and will remain in effect for two years from this date. Instructions for the effective use of M&S in the Acquisition process can be found in the attachment to this memorandum. OPR for this memorandum is SAF/AQR, DSN 332-9301.

ARTHUR L. MONEY
Assistant Secretary of the Air Force
(Acquisition)

Attachment:
Modeling and Simulation in Air Force Acquisition Programs

DISTRIBUTION:
See Attached List

DISTRIBUTION LIST:
HQ AFMC/CC
HQ AFMC/EN
HQ AFMC/XP
AFRL/CC
AF/IL
AF/SC
AF/TE
AF/XO
AF/XP
ASC/CC
ESC/CC
HSC/CC
OC-ALC/CC
OO-ALC/CC
AFPEO/AT
AFPEO/BA
AFPEO/C3
AFPEO/FB
AFPEO/JL
AFPEO/JSF
AFPEO/SP
AFPEO/WP
SA-ALC/CC
SAF/AQC
SAF/AQI
SAF/AQL
SAF/AQP
SAF/AQQ
SAF/AQS
SAF/AQX
SM-ALC/CC
SMC/CC
WR-ALC/CC

MODELING AND SIMULATION (M&S)
IN AIR FORCE ACQUISITION PROGRAMS

1. General Guidance

1.1 M&S is the use of models, including emulators, prototypes, simulators, and stimulators, either statically or over time, to develop data as a basis for making managerial or technical decisions. A model is a physical, mathematical, or otherwise logical representation of a system entity, phenomenon, or process. A simulation is a method of implementing a model over time.

1.2 M&S policy provided in DoDD 5000.1 requires that "models and simulations shall be used to reduce the time, resources, and risks of the acquisition process and to increase the quality of the systems being acquired." DoD 5000.2-R further states that "Accredited modeling and simulation shall be applied, as appropriate, throughout the system life-cycle in support of the various acquisition activities: requirements definition; program management; design and engineering; efficient test planning; results prediction; and to supplement actual test and evaluation; manufacturing; and logistics support."

1.3 Acquisition programs that are developing models or simulations must comply with, and keep abreast of, changes to DoD and Air Force Modeling & Simulation policies, e.g., the designation of the High Level Architecture (HLA) as the standard technical architecture for all DoD owned simulations; Verification, Validation, and Accreditation (VV&A) standards, protocols, and practices; etc.

1.4 Programs will develop a M&S strategy that selects models and simulations based on their effectiveness and efficiency in meeting program goals.

1.5 Digital System Models (DSMs) shall be maintained and updated throughout the program life-cycle. A DSM is a software representation of a system, used to characterize dynamically the expected effects of changes in assumptions, design, tactics, or doctrine. DSMs embody system requirements and characteristics such that they can be actively evaluated in a common digital environment starting with concept exploration and progressing throughout the system life-cycle including analysis, design, test, training, and logistics. Where applicable, the DSM will be specified as a deliverable. User requirements should specify the DSM level of detail and simulation system compatibility. Funding for new DSMs shall be included as part of the initial POM for the weapon system. See Figure 1, Digital System Models.

2. Objective and Role of M&S in System Acquisition

2.1 Our objective is to employ M&S to the maximum extent practicable to achieve the following goals:

- Reduce cost, schedule, performance, and supportability risk
- Reduce time between concept definition and delivery of systems
- Reduce infrastructure and resource usage

- Improve system performance
- Reduce total system life-cycle costs
- Improve system supportability
- Enhance effectiveness of applicable Cost As an Independent Variable (CAIV) trade analyses

2.2 The role of M&S is to make the Air Force Acquisition process more efficient and effective. The goal is to make M&S a standard part of doing business. This includes the development and use of models and simulations that are interoperable, compatible, and reusable. The vision for the use of M&S in Acquisition ideally can be accomplished in an acquisition process where minimum hardware prototyping is done between Phase 0, Concept Exploration, and Phase II, Engineering and Manufacturing Development. Design and prototyping is accomplished using M&S to the maximum extent practicable prior to "bending metal." In this manner, M&S will help ensure the affordability, supportability, and producibility of systems.

2.3 Interoperability is the ability of a model or simulation to provide services (data and functionality) to and accept services from other models and simulations; and to use the services so exchanged to enable them to operate effectively together, e.g., two computers that can lock-up in a synchronized manner and run together in real-time. Compatibility is the capability of a functional unit to meet the requirements of a specified interface, e.g., two computers can talk to each other and exchange data/information, but not necessarily in real-time.

3. **Acquisition Documentation**. Acquisition Documentation shall include plans for the use of M&S, as appropriate, in acquisition programs.

3.1 Single Acquisition Management Plan (SAMP). For ACAT I and II programs, the strategy for using M&S shall be contained in the SAMP. For other programs, the program manager shall address the acquisition strategy in an appropriate document. This strategy will be reviewed during Program Reviews (e.g., Portfolio Reviews, Milestone Reviews, etc.). The goal is to provide visibility links to the past and plans for the future. The SAMP or appropriate document should address the overall M&S acquisition strategy, product reuse, compatibility, ownership and data rights, and VV&A.

3.1.1 Reuse of M&S Products. In developing the M&S acquisition strategy, the Program Manager (PM) shall decide whether to use an existing application, modify an existing application, or develop a new application. If a new M&S application or database must be developed, the M&S strategy documentation must contain an explanation of why existing products are not suitable. In considering product reuse, managers should try to capitalize on commercial M&S efforts. The Air Force Modeling and Simulation Resource Repository (AFMSRR) will provide information on M&S applications available including VV&A data. (Also see paragraph 5.1).

3.1.2 Compatibility. The PM shall identify all M&S applications and databases for which compatibility is required. The goal is to use M&S applications with common format and standards to ensure the M&S applications can exchange data.

3.1.3 M&S Product Ownership. The owner of the M&S product shall be identified early in the acquisition cycle.

3.1.4 VV&A. VV&A procedures must be clearly defined. Plans to train program office personnel in the conduct of VV&A should be discussed. See AFI 16-1001.

3.2 Operational Requirements Document (ORD). PMs shall coordinate with the user during preparation of ORDs to ensure that: 1) they identify those M&S applications and Digital System Models (DSMs) and databases developed by contractors that the Air Force wishes to own or retain access to for later use and 2) compatibility requirements (with other DoD models, simulations, and databases) are clearly stated. Models, simulations, and databases, should strive to be joint, interoperable, reusable, and compatible with the Air Force goal of a Joint Synthetic Battlespace. The requirement for development, update, maintenance, and delivery of DSMs should be included in the ORD by the user.

3.3 Test and Evaluation Master Plan (TEMP). PMs shall include M&S strategies that address applications and testing procedures to insure M&S products satisfy both DT&E/OT&E requirements. This includes test planning and use of DT&E/OT&E results to update models (model-predict-test-compare). These models may be used to predict test results and predict system performance outside of testable regions. Data and other feedback from test results should be used to ensure models accurately reflect system performance. In concert with AFI 16-1001, VV&A shall be addressed to insure credible models for acquisition decisions.

3.4 Solicitation. In the Solicitation, the PM shall discuss expectations and criteria for exploiting M&S. The Solicitation will identify those M&S applications and data requirements the government intends to own, M&S compatibility requirements, and government-owned products, which will be made available to the contractor, e.g., architecture and environment to be used in M&S efforts. The contractor will be encouraged to provide ideas on M&S applications and databases that will reduce cost, schedule, and performance risk.

4. **Acquisition Management Process**. Table 1, Modeling and Simulation Activities in Acquisition, shows acquisition related M&S activities in the acquisition process.

4.1 Pre-Milestone 0 and Concept Exploration (CE). In these phases, a suite of models and simulations, along with supporting data including threat, environment, tactics, etc., are used to conduct mission area assessments, identify program cost drivers, and perform requirements analysis and risk assessments. In CE, the requirement process also identifies deficiencies in M&S products to support acquisition programs. PMs shall work with the user to ensure that the M&S requirements discussed in paragraph 3.2 are contained in the ORD to include the requirement for "Blue" DSMs.

4.2 Program Definition and Risk Reduction (PDRR). M&S in the PDRR phase continues to support and extend activities that were initially conducted in CE. As the focus of development starts shifting toward design of subsystems and components, the models and simulations take on better definition. The types of models and simulations used include hardware/software in-the-

loop simulations, logistics support models, computer-aided design (CAD) and computer-aided manufacturing (CAM) models, cost models, virtual simulations, etc.

4.3 Engineering and Manufacturing Development (EMD). A major focus of M&S in EMD is on engineering-level models, which are used for design, engineering tradeoffs, test planning and support, verification of subsystem and system performance, and verification of compliance with specifications. Models and simulations also support Analysis of Alternatives (AoA) and ORD updates, DT&E/OT&E, and preparations for production and deployment of the system. PMs should:

- Continue to review and update the M&S acquisition strategy and products
- Continue VV&A activities
- Cooperate with the AFMSRR to ensure the M&S applications created are available for reuse by others
- Identify opportunities for M&S in production line setup

4.4 Production and Fielding/Deployment and Operational Support. In this phase, models and simulations can be used to support continued testing, support evaluation and verification of engineering design changes, evaluate effects of design and manufacturing process changes on production, support depot planning for weapons system maintenance, and support decisions to initiate major modifications of the system. PMs should:

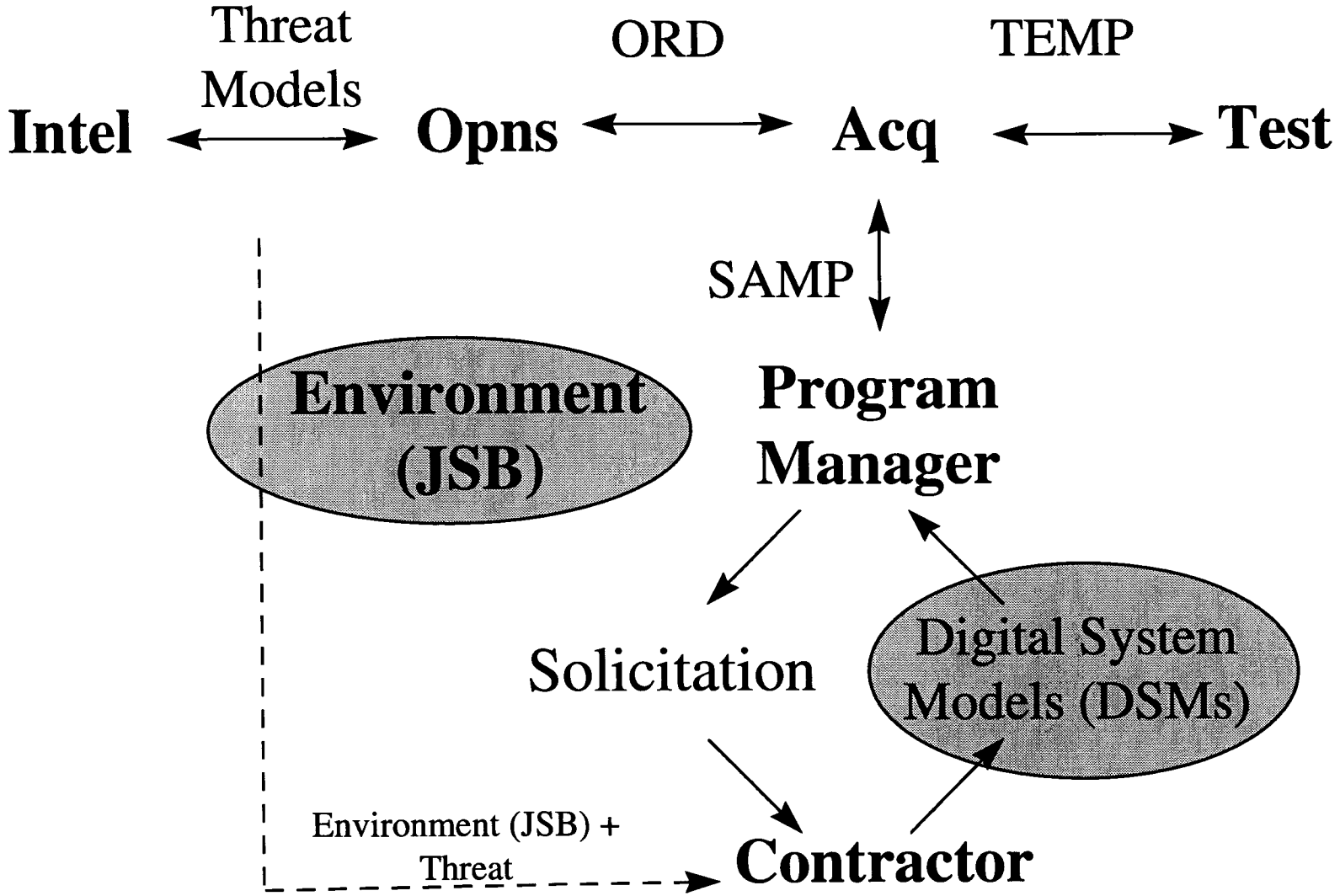
- Continue to review and update the M&S acquisition strategy and products
- Encourage the contractor to use the same models, simulations, and databases for design and manufacturing, combined with the transfer of digital design data directly to the manufacturing floor to reduce errors, rework, and production risk
- Encourage the contractor to use models and databases developed in EMD to simulate manufacturing processes
- Encourage the contractor to use factory simulations for production planning
- Continue refinement and update of models, simulations, and databases for use in operational training situations, testing applications, and accomplishing operational and support effectiveness evaluations

5. **Other M&S Considerations**

5.1 Air Force Modeling and Simulation Resource Repository (AFMSRR). Acquisition managers shall provide AFMSRR information describing the M&S applications and databases they have developed in order that other Air Force programs can reuse them. PMs shall consult with the AFMSRR to see if any of the M&S applications and databases available in the AFMSRR are applicable to their programs. The AFMSRR, as envisioned, will maintain information on M&S applications and databases available, including VV&A data, but it will not own or update M&S products. The M&S application owner will accomplish updating of M&S products. The primary AFMSRR node is located in Orlando, FL. For additional information contact AF/XOCP at DSN 763-5340, ext. 112.

5.2 Education and Training. Program Executive Officers (PEOs), Designated Acquisition Commanders (DACs), and PMs will ensure personnel under their supervision are appropriately trained in M&S related areas. Contact the DSMC M&S Coordinator at DSN 655-5267 for available courses.

5.3 Combat Support. The Joint Vision 2010 concept of Joint Focused Logistics and the Air Force Agile Combat concept are moving from traditional in-theater three-level support, to a transportation-based reach-back support concept. M&S used in Acquisition shall accommodate these and future alternative combat support concepts. Support models should be linked or integrated with operational M&S to allow robust analyses of impacts of support alternatives on operational outcomes.



AoA = Analysis of Alternatives
DSM = Digital System Model
JSB = Joint Synthetic Battlespace
ORD = Operational Requirements Document
SAMP = Single Acquisition Management Plan
TEMP = Test & Evaluation Master Plan

Figure 1. Digital System Models. "Blue DSM requirements are specified in the ORD. These requirements are passed to potential contractors through the Solicitation. The winning contractor maintains/updates the Blue DSM, which originated with AoAs in Phase 0, throughout the program life-cycle, at the appropriate level of detail. Plans to update Blue DSMs are included in the SAMP. Standard threat models and simulated environment are provided to potential contractors by the Government."

MS 0	MS I		MS II	MS III
Pre-Milestone 0	Concept Exploration	Program Definition & Risk Reduction	Engineering & Manufacturing Development	Production, Fielding/Deployment, & Operational Support
Mission Area Assessments: - Use Suite of Models & Simulations MNS - Use Campaign & Theater Level Models in Conjunction With Results of Lower Level Models DSM	ORD Generation - Use Operational Effectiveness and Supportability Models AoA - Use Cost and Operational Effectiveness Models - Use Support Models Solicitation - Specify Government-owned M&S Products - Identify M&S Requirements System Cost Estimates - Use Cost Models (Program & Life Cycle) Program Planning - Use Schedule, Risk, Plans Models DSM	SAMP - M&S Strategy - Use Repository - VV&A Systems Engineering - Use Engineering Models & Simulations of Proposed System for Specification Development - Use Hardware/Software-in-the-Loop for Design Evaluation and Risk Reduction - Use CAD/CAM for Design and Producibility Planning - Use Support & Operational Models to Evaluate Logistics/ Combat Support Concepts & Plans TEMP - Plan M&S Applications to be Used in DT&E/OT&E - Plan Use of DT&E/OT&E to Validate Models - Establish Test Facility M&S Compatibility Requirements DSM	Review M&S Requirements and Products Being Used T&E - Use M&S to Quantify Test Conditions, Design Tests, and Predict, Quantify, & Extrapolate Test Results Continue VV&A Activities Coordinate With AFMSRR for M&S Reuse Production Planning - Use Manufacturing Process Models - Use Factory Simulations Logistics Planning - Use M&S to Identify Logistics Support Tasks & Requirements, and Complete Support Plans DSM	Update Manufacturing Process Models & Factory Simulations Use Operations & Support Tracking & Prediction Models Update M&S Tools for FOT&E Provide M&S Applications Descriptions to Repository Evaluate Operations & Support Deficiencies and Analyze Alternative Corrective Actions DSM

Table 1. Modeling and Simulation Activities in Acquisition